

Overview:

Scientific and Engineering Research Facilities at Colleges and Universities: 1998

Background

The availability, condition, and adequacy of the physical facilities needed to conduct science and engineering (S&E) research at our nation's colleges and universities have long been a concern of policy makers, higher education administrators, and scientists and engineers. In particular, questions about the following critical issues have been raised:

- How much space is there for conducting S&E research?
- Is this enough space to meet the nation's S&E research needs?
- What is the condition of this space?
- How much new S&E space needs to be constructed? How much of the existing S&E space needs repair or renovation?
- How much construction and repair/renovation is taking place and what does it cost?
- How do colleges and universities fund these capital projects?
- How has the situation changed over the past decade?

Educators and policy makers have been particularly concerned about the quantity and quality of S&E research space at nondoctorate-granting institutions (those dedicated primarily to undergraduate education) and minority-serving institutions (those with relatively large percentages of minority students). These institutions contribute to the scientific enterprise by providing students with the science and engineering education necessary to pursue advanced education and training as well as research and teaching careers in science and engineering.

In the mid-1980s, both the U.S. House of Representatives and the Senate held hearings at which experts testified about the seriousness of the condition of the nation's S&E research facilities. As a result, Congress mandated that the National Science Foundation (NSF) collect and analyze data that address a range of S&E research facilities issues. The mandate states:

The National Science Foundation is authorized to design, establish, and maintain a data collection and analysis capability in the Foundation for the purpose of identifying and assessing the research facilities needs of universities and colleges. The needs of universities by major field of science and engineering, for construction and modernization of research laboratories, including fixed equipment and major research equipment, shall be documented. University expenditures for the construction and modernization of research facilities, the sources of funds, and other appropriate data shall be collected and analyzed. The Foundation, in conjunction with other appropriate Federal agencies, shall report the results to Congress. The first report shall be submitted to Congress by September 1, 1986 (42 U.S.C. 1886).

On a biennial basis since 1986, NSF has collected data on S&E research facilities in the nation's research-performing colleges and universities. This overview presents the major findings from the 1998 survey and provides a summary of changes that have taken place between the 1988 and 1998 surveys. A brief description of the study's methods precedes a discussion of its major findings.

Survey Methods

The 1998 *Survey of Scientific and Engineering Research Facilities at Colleges and Universities* was mailed to a sample of 365 institutions in February 1998. This sample represents 660 colleges and universities that either had research and development (R&D) expenditures of \$50,000 or more in 1993, or were minority-serving institutions that had any R&D expenditures in that year.¹ Of these 660 research-performing institutions, 57 percent were doctorate-granting and 43 percent were nondoctorate-granting. The doctorate-granting institutions consist of two groups: the 100 institutions with the largest R&D expenditures, referred to throughout the report as the top 100 ; and the other 278 institutions, which are referred to as other doctorate-granting institutions.

In 1998, for the first time, respondents could complete the survey either electronically over the Internet² or by hand on paper. Institutions that participated in the 1996 survey were sent a computer-generated facsimile of their previous responses. Extensive telephone follow-up elicited a high response rate and reduced the number of items that respondents had initially omitted or responded to inconsistently. In all, 304, or 87 percent of all qualified sampled institutions, completed the survey, including all of the top 100. Of these 304, 53 percent responded via the Internet and 47 percent completed the paper version of the survey. (See *Scientific and Engineering Research Facilities at Colleges and Universities: 1998*, Appendix A, Technical Notes, for a detailed description of the sampling procedures and data-collection methods.)

¹ Throughout this report, these 660 colleges and universities are referred to as research-performing institutions. Except where explicitly stated otherwise, the statistics presented in the report are for the weighted values of all institutions represented in the sample.

² In 1996, a Windows-based disk version of the survey was provided as an option.

How Much S&E Research Space Do Colleges and Universities Have?

In 1998, the nation's colleges and universities had 488 million net assignable square feet (NASF)³ of academic space. Fifty-nine percent of this space, 286 million NASF, was dedicated to instruction and research in science and engineering. Half of this S&E space, 143 million NASF, was devoted specifically to research (Table 1).

Table 1. Amount of space by institution type: 1998

| Institution type | Number of institutions | Instructional and research space in all academic fields ¹ | Instructional and research space in S&E fields | Research space in S&E fields |
|--|------------------------|--|--|------------------------------|
| Net assignable square feet in millions | | | | |
| Total | 660 | 488 | 286 | 143 |
| Doctorate-granting: | 378 | 416 | 261 | 136 |
| Top 100 in research expenditures | 100 | 252 | 177 | 101 |
| Other | 278 | 164 | 84 | 35 |
| Nondoctorate-granting | 282 | 72 | 25 | 7 |

¹Projected from the responses of 92 percent of the institutions.

NOTE: Values may not add to totals due to rounding.

SOURCE: National Science Foundation/SRS, *1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities*.

The nation's S&E research space was distributed across the three types of research-performing institutions as follows (Figure 1):

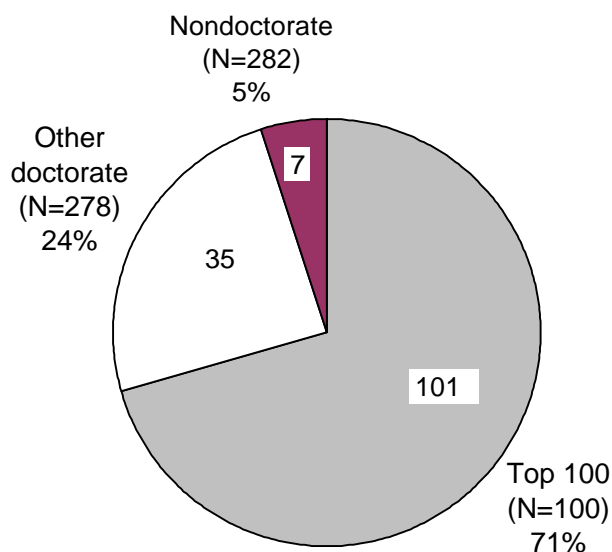
- The top 100 institutions, which represent 15 percent of all research-performing institutions, occupied 71 percent of this space (101 million NASF);
- The other doctorate-granting institutions, which represent 42 percent of all research-performing institutions, occupied 24 percent of this space (35 million NASF); and

³ Net assignable square feet is defined as the sum of all areas, in square feet, on all floors of a building assigned to, or available to be assigned to, an occupant for specific use.

- The nondoctorate granting institutions, which represent 43 percent of all research-performing institutions, occupied 5 percent of this space (7 million NASF).

It should also be noted that while the top 100 institutions represent 15 percent of the total number of research-performing institutions, they accounted for 80 percent of all R&D expenditures in 1993. Thus, the proportion of S&E research space that they occupy, 71 percent, is roughly proportional to their share of total R&D expenditures.

Figure 1. Amount of science and engineering (S&E) research space by institution type: 1998 (NASF in millions)



Source: National Science Foundation/SRS, 1998 *Survey of Scientific and Engineering Research Facilities at Colleges and Universities*.

Almost three quarters (72 percent or 103 million NASF) of the nation's S&E research space is concentrated in five fields (Table 2):

- The agricultural sciences 17 percent or 25 million NASF;
- Engineering 16 percent or 23 million NASF;
- The biological sciences outside medical schools 13 percent or 19 million NASF;
- The physical sciences 13 percent or 18 million NASF; and
- The medical sciences in medical schools 13 percent or 18 million NASF.

Is the Amount of S&E Research Space Adequate for Current Research Commitments?

In light of their current research commitments, at least half of all institutions reported inadequate amounts of space in every S&E field except mathematics, where 41 percent of the institutions indicated that the amount of research space was inadequate (Table 2). At least 60 percent of all research-performing institutions reported that their research space was inadequate in each of the following five S&E fields:

- The biological sciences in medical schools – 70 percent of institutions reported having inadequate space;⁴
- The medical sciences in medical schools – 67 percent of institutions;
- The biological sciences outside medical schools – 64 percent of institutions;
- The physical sciences – 63 percent of institutions; and
- The earth, atmospheric, and ocean sciences – 60 percent of institutions.

To meet their current research commitments, the research-performing institutions reported that they needed an additional 41 million NASF of S&E research space, or 29 percent more than they currently have. Three million or more NASF of research space were needed in each of the following six S&E fields (Table 2):

- The biological sciences outside medical schools (7 million NASF);
- The physical sciences (6 million NASF);
- Engineering (6 million NASF);
- The medical sciences in medical schools (5 million NASF);
- The medical sciences outside medical schools (3 million NASF); and
- The agricultural sciences (3 million NASF).

⁴ Reported percentages of institutions include only those that had any research space in the field. For example, there were 127 institutions with biological science research space in medical schools (Table 2), of which 70 percent (89) reported having inadequate space. By comparison, 556 institutions reported having research space in the biological sciences outside of medical schools. Sixty-four percent of these institutions, or 356, indicated that the amount of space in this field was inadequate.

Table 2. Existing and needed science and engineering research space by field: 1998

| Field | Number of institutions with space | Existing NASF (in millions) | Percent reporting inadequate space | Needed NASF (in millions) |
|---|-----------------------------------|-----------------------------|------------------------------------|---------------------------|
| TOTAL | 660 | 143 | 81% | 41 |
| Biological sciences-- outside medical school | 556 | 19 | 64 | 7 |
| Physical sciences | 545 | 18 | 63 | 6 |
| Psychology | 464 | 3 | 50 | 1 |
| Social sciences | 413 | 5 | 59 | 3 |
| Mathematics | 396 | 1 | 41 | 1 |
| Computer sciences | 367 | 2 | 52 | 1 |
| Earth, atmospheric, and ocean sciences | 348 | 8 | 60 | 2 |
| Engineering | 290 | 23 | 58 | 6 |
| Agricultural sciences | 108 | 25 | 55 | 3 |
| Medical sciences-- outside medical school | 262 | 7 | 50 | 3 |
| Medical sciences-- medical school | 127 | 18 | 67 | 5 |
| Biological sciences-- medical school | 127 | 12 | 70 | 3 |
| Other sciences | 149 | 3 | 32 | 1 |

NOTE: Values may not add to totals due to rounding.

SOURCE: National Science Foundation/SRS, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

What is the Condition of the Nation's S&E Research Space?

Over a third (39 percent or 56 million NASF) of S&E research space at research-performing institutions was rated as "suitable for the most scientifically sophisticated research." However, the research-performing institutions classified 18 percent (26 million NASF) of their research space as needing major renovation and another 5 percent (7 million NASF) as needing replacement. Thus, almost one quarter (23 percent) of all S&E research space requires either major renovation or replacement. Fields with the greatest amount of research space needing major renovation or replacement include:

- The agricultural sciences (7.5 million NASF);
- The biological sciences outside medical schools (4.8 million NASF);
- The medical sciences in medical schools (4.6 million NASF);
- Engineering (4.3 million NASF); and
- The physical sciences (3.9 million NASF).

How Much Construction and Repair/Renovation Has Been Deferred?

In 1998, 55 percent of research-performing institutions reported that they had to defer needed S&E construction or repair/renovation projects that would support their current research program commitments because of insufficient funds. The vast majority of institutions that had deferred projects (87 percent) had included at least some of these projects in an approved institutional plan.

The total estimated cost for deferred S&E research construction and repair/renovation projects (both in and not in an institutional plan) was \$11.4 billion in 1998. Deferred construction projects accounted for \$7 billion (61 percent) of these costs, while deferred repair/renovation projects accounted for the other \$4.4 billion (39 percent).

Deferred construction costs exceeded \$1 billion in each of three fields. Institutions reported deferred repair/renovation costs in excess of \$500 million in the same three fields. These fields and the deferred costs are:

- The physical sciences: \$1.6 billion in deferred construction and \$901 million in deferred repair/renovation;
- The biological sciences outside medical schools: \$1.2 billion in deferred construction and \$853 million in deferred repair/renovation; and
- Engineering: \$1.0 billion in deferred construction and \$700 million in deferred repair/renovation.

How Much S&E Construction and Repair/Renovation Did Institutions Start in 1996 and 1997?

New construction projects begun in 1996 and 1997 are expected to produce 11.2 million NASF of new S&E research space. This space is the equivalent of about 8 percent of existing research space.⁵ Similarly, new repair/renovation projects begun in 1996 and 1997 are expected to upgrade 15.1 million NASF, about 11 percent of existing research space.

In 1996 and 1997, institutions were less likely to start new construction projects than they were to start repair/renovation projects. Overall, one third of institutions (32 percent) started new S&E construction projects in 1996 and 1997 and over half (52 percent) started repair/renovation projects (Table 3).

Institutions were most likely to start construction projects in the following fields

- The medical sciences in medical schools – 32 percent of the institutions that had space;⁶
- The agricultural sciences – 28 percent of institutions; and
- The earth, atmospheric, and ocean sciences – 21 percent of institutions.

Similarly, institutions were most likely to start repair/renovation projects that cost over \$100,000 in the following fields:

- The biological sciences in medical schools – 51 percent of institutions;
- The medical sciences in medical schools – 41 percent of institutions;
- Engineering – 35 percent of institutions; and
- The physical sciences – 31 percent of institutions.

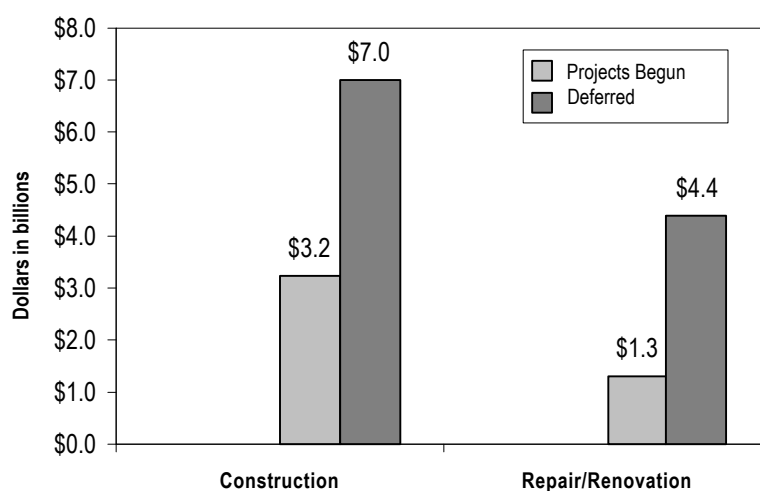
⁵ Because some newly constructed S&E research space replaces existing space, the reader is cautioned against adding NASF under construction to existing NASF to obtain a total NASF once construction is completed. In addition, it should not be assumed that space being constructed is necessarily the same space that institutions report as needed in any given field in 1998.

⁶ Percentages are reported only for those institutions that have space in a given S&E field.

How Much Are S&E Construction and Repair/Renovation Projects Expected to Cost?

New construction projects begun in 1996 and 1997 are expected to cost \$3.2 billion. Institutions reported an additional \$7.0 billion of estimated deferred construction costs. Similarly, new repair/renovation projects begun in 1996 and 1997 are expected to cost \$1.3 billion and estimated deferred repair/renovation costs totaled \$4.4 billion (Figure 2).

Figure 2. Costs of construction and repair/renovation of science and engineering research facilities begun in 1996 and 1997, and estimated deferred costs in 1998 (NASF in millions)



Source: National Science Foundation/SRS, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities

Four fields account for more than half (59 percent) of the \$3.2 billion committed to the construction of new research space started in 1996 and 1997 (Table 3).

- The medical sciences in medical schools (\$784 million);
- The biological sciences outside medical schools (\$404 million);
- The physical sciences (\$381 million); and
- Engineering (\$332 million).

Five fields account for more than three quarters (76 percent) of the \$1.3 billion committed to the repair/renovation of research space:

- The physical sciences (\$244 million);
- Engineering (\$208 million);
- The biological sciences outside medical schools (\$200 million);
- The medical sciences in medical schools (\$196 million); and
- The biological sciences in medical schools (\$164 million).

Table 3. Construction and repair/renovation activity by science and engineering field: 1996 and 1997

| Field | Percent of institutions starting new construction | Cost of new construction (in millions) | Percent of institutions starting repair/renovation | Cost of repair/renovation (in millions) |
|---|---|--|--|---|
| TOTAL | 32% | \$3,229 | 52% | \$1,325 |
| Biological sciences-- outside medical school | 13 | 404 | 29 | 200 |
| Physical sciences | 12 | 381 | 31 | 244 |
| Psychology | 4 | 77 | 8 | 65 |
| Social sciences | 5 | 75 | 12 | 40 |
| Mathematics | 0 | 9 | 3 | 5 |
| Computer sciences | 1 | 21 | 5 | 12 |
| Earth, atmospheric, and ocean sciences | 21 | 291 | 12 | 52 |
| Engineering | 11 | 332 | 35 | 208 |
| Agricultural sciences | 28 | 273 | 25 | 50 |
| Medical sciences-- outside medical school | 9 | 259 | 25 | 76 |
| Medical sciences-- medical school | 32 | 784 | 41 | 196 |
| Biological sciences-- medical school | 14 | 178 | 51 | 164 |
| Other sciences | 10 | 145 | 17 | 11 |

NOTES: 1. Only projects costing \$100,000 or more

2. The percent of institutions starting new construction or repair/renovation projects in a given field reflects only those institutions that have research space in that field. It does not reflect all 660 research-performing institutions.

3. Values may not add to totals due to rounding.

SOURCE: National Science Foundation/SRS, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

How are Colleges and Universities Funding S&E Capital Projects?

Overall, the research-performing institutions derived their S&E capital projects funds from three major sources: the Federal government, state and local governments, and institutional resources. Institutional resources consist of private donations, institutional funds, tax-exempt bonds, other debt sources, and other sources (Table 4).

Although more than twice as many dollars from each source were allocated to construction project expenses (\$3.2 billion) than to repair/renovation project expenses (\$1.3 billion), the funds from each source were used in similar proportions, regardless of the type of project. Institutional resources were the largest source of funds for both types of projects:

- Institutional resources accounted for 61 percent (\$1,972 million) of all construction funds and 65 percent (\$866 million) of all repair/renovation funds;
- State and local governments accounted for 31 percent (\$985 million) of all construction funds and 26 percent (\$338 million) of all repair/renovation funds; and
- The Federal government directly accounted for 8 percent of all construction funds (\$272 million) and 9 percent (\$121 million) of all repair/renovation funds. Additionally, some Federal funding comes through overheads on grants and/or contracts from the Federal government. These overhead payments are used to defray the indirect costs of conducting federally funded research and are counted as institutional funding.

Table 4. Source of funds to construct and repair/renovate science and engineering research space: 1996 and 1997

| Source of Funds | Percent of funds for new construction | Percent of funds for repair/renovation |
|------------------------|---------------------------------------|--|
| Federal Government | 8% | 9% |
| State/Local Government | 31 | 26 |
| Institutional Sources | 61 | 65 |
| TOTAL | 100 | 100 |
| TOTAL COSTS | \$3.2 billion | \$1.3 billion |

NOTE: Only projects costing \$100,000 or more

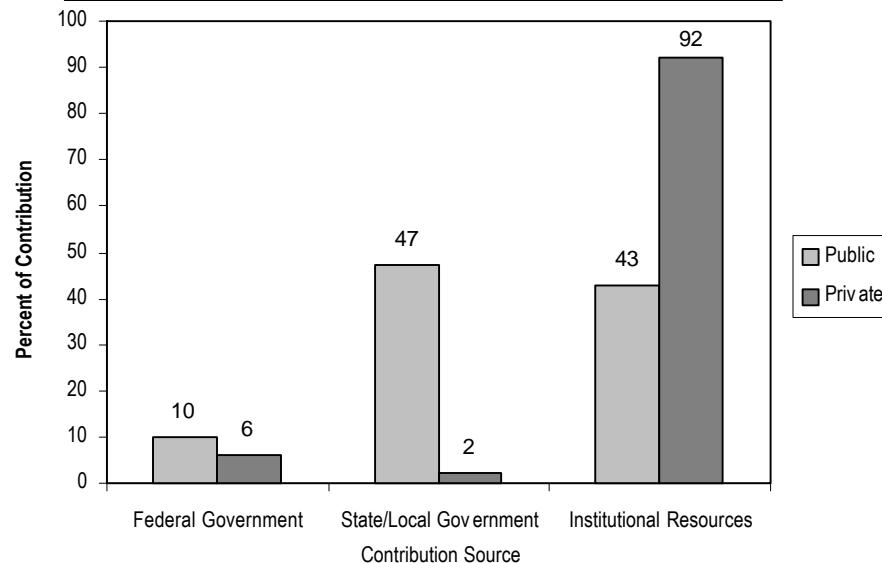
SOURCE: National Science Foundation/SRS, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

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The relative distribution of the three sources of funds for S&E construction and repair/renovation projects differed between the public and private research-performing institutions. The relative distribution of construction funds between institution types is as follows (Figure 3):

- Institutional resources accounted for 43 percent (\$872 million) of all construction funds at public institutions and 92 percent (\$1,101 million) at private institutions;
- State and local governments accounted for 47 percent (\$958 million) of all construction funds at public institutions and 2 percent (\$27 million) at private institutions; and
- The Federal government accounted for 10 percent (\$201 million) of all construction funds at public institutions and 6 percent (\$70 million) of all construction funds at private institutions.

Figure 3. Source of funds for construction of new science and engineering research space by control of institution, 1996 and 1997

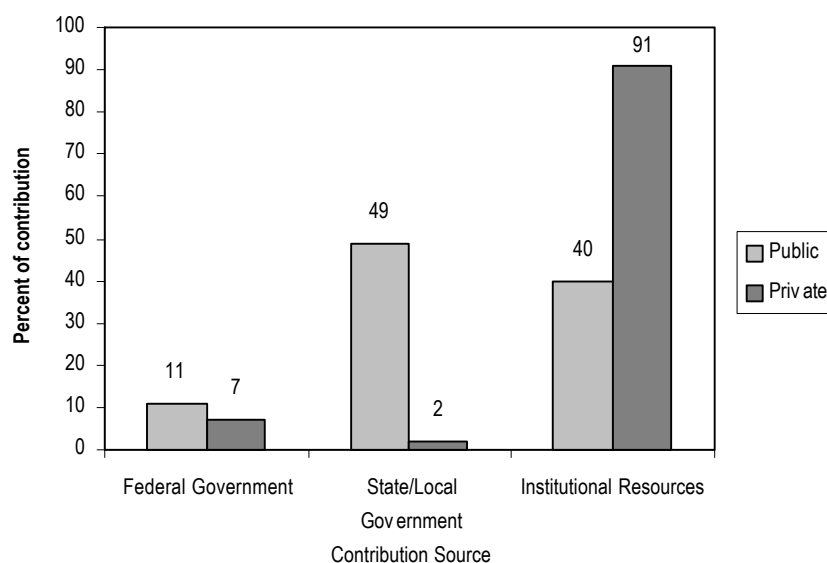


Source: National Science Foundation/SRS, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

The relative distribution of repair/renovation funds between institution types is as follows (Figure 4):

- Institutional resources accounted for 40 percent (\$269 million) of all repair/renovation funds at public institutions and 91 percent (\$596 million) at private institutions;
- State and local governments accounted for 49 percent (\$328 million) of all repair/renovation funds at public institutions and 2 percent (\$10 million) at private institutions; and
- The Federal government accounted for 11 percent (\$72 million) of all repair/renovation funds at public institutions and 7 percent (\$48 million) at private institutions.

Figure 4. Source of funds for repair/renovation of science and engineering research space by control on institution, 1996 and 1997



Source: National Science Foundation/SRS, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Special Types of Institutions

S&E Research Space at Minority-Serving Institutions

Since its inception, the *Survey of Scientific and Engineering Research Facilities at Colleges and Universities* has included a sample of Historically Black Colleges and Universities (HBCUs). These institutions have been recognized for their contributions to the education of Black students in general and for their role in preparing students for science and engineering careers. NSF has recognized the growth in minority enrollments in higher education overall and, thus, added two other types of minority-serving institutions to the 1998 sample. The inclusion of non-HBCU Black institutions acknowledges the fact that there are many colleges and universities that enroll large percentages of Black students but are not designated as HBCUs. Similarly, as Hispanic enrollments in higher education increase, there is a need to examine institutions serving these students. The group of minority-serving institutions varies in size and focus; it is composed of both nondoctorate and doctorate-granting institutions, and includes one of the top 100 research-performing institutions. Below is a summary of some of the key characteristics of minority-serving institutions:

- **Number of institutions:** The nation's 660 research-performing institutions include 57 HBCUs, 13 non-HBCU Black-serving institutions, and 10 Hispanic-

serving institutions. These 80 institutions comprise 12 percent of all research-performing institutions.

- **Amount of S&E research space:** The minority-serving institutions contain 3.9 million NASF of S&E research space, or 3 percent of the total amount of research space across all research-performing institutions.
- **S&E research space by field:** Four fields account for 71 percent of all the S&E research space in minority-serving institutions: engineering, 960,000 NASF; the agricultural sciences, 710,000 NASF; the physical sciences, 543,000 NASF; and the biological sciences outside of medical schools, 519,000 NASF.
- **Adequacy of amount of space:** At least 60 percent of the minority-serving institutions report inadequate amounts of S&E research space in five fields: the biological sciences outside of medical schools; the physical sciences; the earth, atmospheric, and ocean sciences; medical sciences in medical schools; and biological sciences in medical schools.
- **Condition of research space:** Eighteen percent of the S&E research space (694,000 NASF) is reported to require either major renovation or replacement.
- **Construction activity:** Twenty-six percent of the minority-serving institutions started S&E construction projects in either 1996 or 1997. The cost of these projects at the time they were started was \$121 million. The cost of these projects represented 4 percent of the total S&E construction costs undertaken at all research-performing institutions.
- **Repair/renovation activity:** Twenty-nine percent of the minority-serving institutions started S&E repair/renovation projects in either 1996 or 1997. The cost of these projects at the time they were started was approximately \$36 million. The cost of these projects represented 3 percent of the total across all research-performing institutions.
- **Sources of funding:** State and local governments were the primary funding source for both construction and repair/renovation projects over \$100,000 in minority-serving institutions, followed by institutional resources (Table 5).

Table 5. Source of funds to construct and repair/renovate science and engineering research space at minority-serving institutions: 1996 and 1997

| Source of Funds | Percent of funds for new construction | Percent of funds for repair/renovation |
|------------------------|---------------------------------------|--|
| Federal Government | 20% | 17% |
| State/Local Government | 42 | 63 |
| Institutional Sources | 38 | 20 |
| TOTAL | 100% | 100% |
| TOTAL COSTS | \$121 million | \$36 million |

NOTE: Only projects costing \$100,000 or more

SOURCE: National Science Foundation/SRS, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

S&E Research Space at Nondoctorate-Granting Institutions

Many scientists and engineers receive their undergraduate training at institutions that do not award doctoral degrees. The visibility of these institutions has increased in recent years as policy makers recognize these institutions' contributions to the production not only of practicing scientists and engineers, but of technical workers and science and mathematics teachers for our nation's elementary and secondary schools. Below is a summary of some of the key characteristics of nondoctorate-granting institutions:

- **Number of institutions:** The nation's 660 research-performing institutions include 191 institutions that award masters' degrees and 91 institutions that award primarily baccalaureate degrees. These institutions, referred to as nondoctorate-granting institutions, represent 43 percent of all research-performing institutions.
- **Amount of S&E research space:** The nondoctorate-granting institutions account for 7.4 million NASF of S&E research space, or approximately 5 percent of all S&E research space across all research-performing institutions.
- **S&E research space by field:** The nondoctorate-granting institutions were most likely to have S&E research space in the biological sciences outside of medical schools (87 percent of institutions) and the physical sciences (85 percent). These two fields alone account for almost half (48 percent) of their total S&E research space.
- **Adequacy of amount of research space:** Over half of the nondoctorate-granting institutions indicated that the amount of S&E research space was inadequate in the two fields in which they were most likely to have space: the biological sciences outside of medical schools (66 percent) and the physical sciences (67 percent). In addition, more than half of the institutions reported inadequate space in three fields: earth, atmospheric, and ocean sciences (58 percent), computer sciences (56 percent), and the social sciences (57 percent).
- **Condition of research space:** Almost a third, 31 percent, of all S&E research space in the nondoctorate-granting institutions was considered to need major renovation or replacement.
- **Construction activity:** Over a fifth, 22 percent, of the nondoctorate-granting institutions started S&E construction projects in either 1996 or 1997. The cost of these projects at the time they were started was approximately \$275 million. This cost represented approximately 9 percent of the total S&E construction undertaken in all research-performing institutions.
- **Repair/renovation activity:** Almost a third, 32 percent, of the nondoctorate-granting institutions started S&E repair/renovation projects in either 1996 or 1997. The cost of these projects at the time they were started was approximately \$182 million, or 14 percent of the total across all research-performing institutions.

- **Sources of funding:** Institutional sources were the primary funding source for construction and repair/renovation projects over \$100,000 in nondoctorate-granting institutions (Table 6).

Table 6. Source of funds to construct and repair/renovate science and engineering research space at nondoctorate-granting institutions: 1996 and 1997

| Source of Funds | Percent of funds for new construction | Percent of funds for repair/renovation |
|------------------------|---------------------------------------|--|
| Federal Government | 1% | 14% |
| State/Local Government | 32 | 36 |
| Institutional Sources | 67 | 51 |
| TOTAL | 100% | 100% |
| TOTAL COSTS | \$275 million | \$182 million |

Only projects costing \$100,000 or more

NOTE: Values may not add to totals due to rounding.

SOURCE: National Science Foundation/SRS, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Animal Research Space

The 83 percent of research-performing institutions that have animal laboratory facilities reported a total of 11.9 million NASF of animal research space. This represents 8 percent of all S&E research space.

The distribution of animal research space across types of institutions parallels the distribution of all S&E research space. In addition, the proportion of animal research space as a part of all S&E research space is roughly 8 percent at each type of institution:

- The top 100 institutions account for 71 percent (101 million NASF) of all S&E research space and have 71 percent (8.5 million NASF) of all animal research space;
- The other doctorate-granting institutions occupy 24 percent (35 million NASF) of all S&E research space and have 23 percent (2.7 million NASF) of all animal research space; and
- The nondoctorate-granting institutions occupy 5 percent (7 million NASF) of all S&E research space and have 5 percent (0.6 million NASF) of all animal research space.

Looking Back Over the Decade

The 1998 *Survey of Scientific and Engineering Research Facilities at Colleges and Universities* provides an opportunity to examine the status of the nation's S&E research facilities over a ten-year period.⁷ While some aspects of facilities (e.g., the amount of space) have changed gradually and steadily over the decade, other aspects (e.g., construction and repair/renovation starts) have tended to fluctuate over this period.⁸

Amount of Research Space

The amount of S&E research space in the nation's research-performing colleges and universities has grown continuously over the decade. In 1988, there were 112 million NASF of research space. Ten years later, there were 143 million NASF, a 28 percent increase. Doctorate-granting institutions account for most of the growth in actual S&E research space over this period (Figure 5).

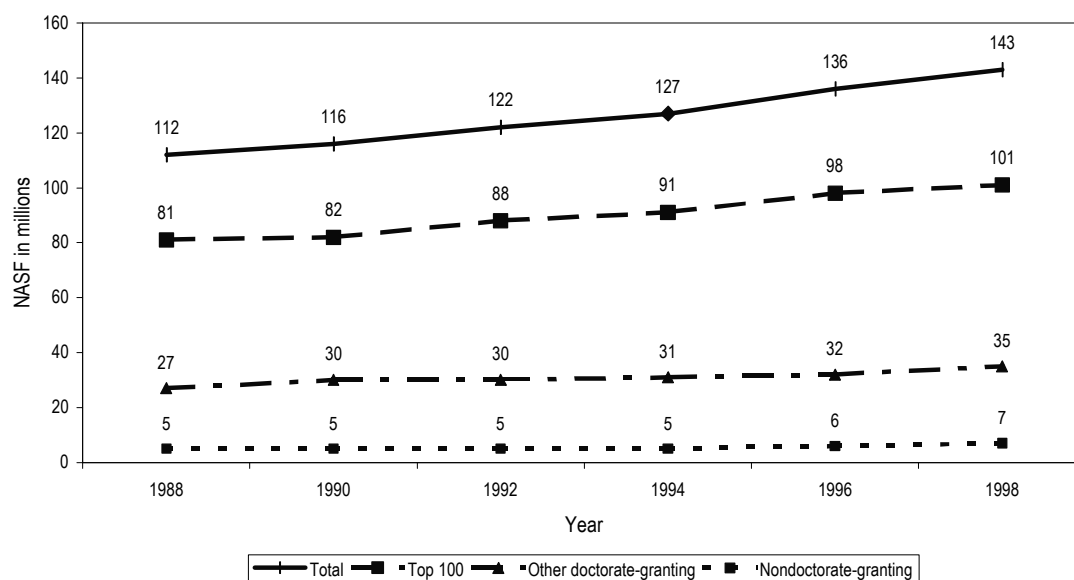
- At the top 100 institutions, S&E research space increased by 25 percent or 20 million NASF (from 81 million NASF to 101 million NASF);
- At other doctorate-granting institutions, S&E research space increased by 30 percent or 8 million NASF (from 27 million NASF to 35 million NASF); and
- At nondoctorate-granting institutions, S&E research space increased by 40 percent or 2 million NASF (from 5 million NASF to 7 million NASF).

Increases in the amount of S&E research space in the individual S&E fields were gradual and fairly even across fields.

⁷ While the *Survey of Scientific and Engineering Research Facilities at Colleges and Universities* has collected data on a number of the same issues over time, modifications to individual questions have occurred and new questions that address issues that arose between survey periods have been added. It should also be noted that the institutions sampled change over time, particularly for the other doctorate-granting and nondoctorate-granting groups. In addition, the classification of some institutions changed, e.g., institutions that did not grant doctorate degrees in one period did so at a later period. The sampling frame, however, has always reflected those institutions with R&D expenditures of \$50,000 or more and, starting in 1992, Historically Black Colleges and Universities with any R&D expenditure.

⁸ We limit our discussion to changes over time where the 1986-87 estimate falls outside the 1996-97 estimate's 95 percent confidence interval.

Figure 5. Trends in amount of science and engineering research space by institution type: 1988-1998



Source: National Science Foundation/SRS, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

The Condition of S&E Research Space

In 1988, 24 percent of all research space was rated as "suitable for the most scientifically sophisticated research," whereas in 1998, 39 percent of all of research space was rated as being in this highest quality condition. The amount of research space reported to need major renovation or replacement to meet current research commitments also has increased continuously, from 16 percent to 23 percent over the past ten years. In 1988, 17.7 million NASF of all S&E research space required repair or renovation compared with 32.9 million NASF in 1998.

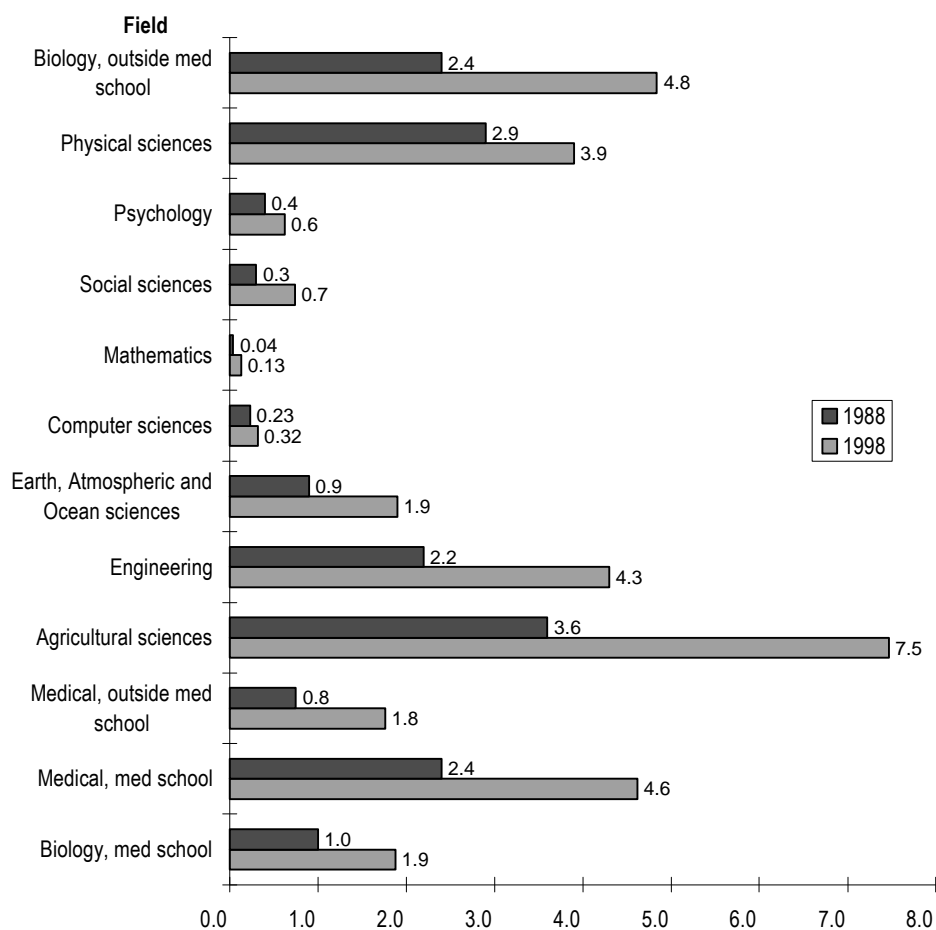
In this ten-year period, the amount of research space requiring renovation or replacement has increased in every S&E field. In nine out of the twelve fields, the amount of research space in this condition has nearly doubled over the decade (Figure 6).⁹

- The social sciences research space in need of renovation or replacement increased from 0.3 million NASF to 0.7 million NASF;
- The medical sciences outside medical schools: from 0.8 million NASF to 1.8 million NASF;
- The earth, atmospheric, and ocean sciences: from 0.9 million NASF to 1.9 million;

⁹ Due to differences in the standard errors of each estimate, changes over time of the same magnitude may not have the same interpretation.

- The agricultural sciences: from 3.6 million NASF to 7.5 million NASF;
- The biological sciences outside medical schools: from 2.4 million NASF to 4.8 million NASF;
- The biological sciences in medical schools: from 1.0 million NASF to 1.9 million NASF;
- The medical sciences in medical schools: from 2.4 million NASF to 4.6 million NASF;
- Engineering: from 2.2 million NASF to 4.3 million NASF; and
- Mathematics: from .04 million NASF to .13 million NASF.

Figure 6. Amount of existing research science and engineering space needing major renovation or replacement by field: 1988 and 1998 (NASF in millions)



Source: National Science Foundation/SRS, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities; National Science Foundation/SRS, Scientific and Engineering Research Facilities at Colleges and Universities, 1996, Table 2-3, p 2-6.

New Construction and Repair/Renovation Projects

The amount of new research space under construction and the amount of research space affected by repair/renovation projects have fluctuated over time. In 1996 and 1997, research-performing institutions began construction on 11.2 million NASF; in 1986 and 1987, construction was begun on 9.9 million NASF. The amount of S&E research space affected by new repair/renovation projects in 1996 and 1997 was 15.1 million NASF; the amount of research space repaired or renovated in 1986 and 1987 was 13.4 million NASF.

Overall, the proportion of institutions (32 percent) starting construction projects in 1996 and 1997 is consistent with the proportion (37 percent) that started construction projects ten years earlier, in 1986 and 1987. However, the proportion of institutions beginning new construction projects in three fields changed over the decade:

- The earth, atmospheric, and ocean sciences increased from 9 percent of institutions to 21 percent;
- Engineering decreased from 28 percent of institutions to 11 percent ; and
- The agricultural sciences decreased, from 38 percent of institutions to 28 percent.

The proportion of institutions (52 percent) starting new repair/renovation projects in 1996 and 1997 was also similar to the proportion (56 percent) that started repair/renovation projects in 1986 and 1987. However, a change in the proportion of institutions beginning new repair/renovation projects over the decade occurred in four fields:

- The physical sciences increased from 22 percent of institutions to 31 percent;
- Engineering decreased from 42 percent of institutions to 35 percent;
- The medical sciences outside medical schools increased from 12 percent of institutions to 25 percent; and
- The medical sciences in medical schools decreased from 54 percent of institutions to 41 percent.

The Cost of Construction and Repair/Renovation Projects

The total costs of new construction and repair/renovation projects have fluctuated over time. However, in 1996 and 1997, research-performing institutions committed 19 percent more funds (in inflation-adjusted dollars) for capital projects than they did a decade ago. In 1986 and 1987, they committed \$2.7 billion to new construction

projects compared with \$3.2 billion in 1996 and 1997; and \$1.1 billion to repair/renovation compared with \$1.3 billion in 1996 and 1997 ¹⁰ (Figure 7).

Although the amount of funds committed to new construction projects costing over \$100,000 has varied over time by field, construction expenditures approximately doubled or more in two fields:

- In the earth, atmospheric, and ocean sciences, the amount of funds increased \$216 million, from \$75 million to \$291 million; and
- In the medical sciences in medical schools, the amount of funds for new construction projects increased \$385 million, from \$399 million to \$784 million.

The amount of funds committed to repair/renovation projects costing over \$100,000 has also varied over time by field. The repair/renovation expenditures increased in four fields:

- In psychology, the amount of funds committed to repair/renovation projects increased \$47 million, from \$18 million to \$65 million;
- In the earth, atmospheric, and ocean sciences, the amount of funds increased \$25 million, from \$27 million to \$52 million;
- In the physical sciences, the amount of funds increased \$105 million, from \$139 million to \$244 million; and
- In the biological sciences in medical schools, the amount of funds increased \$62 million, from \$102 million to \$164 million.

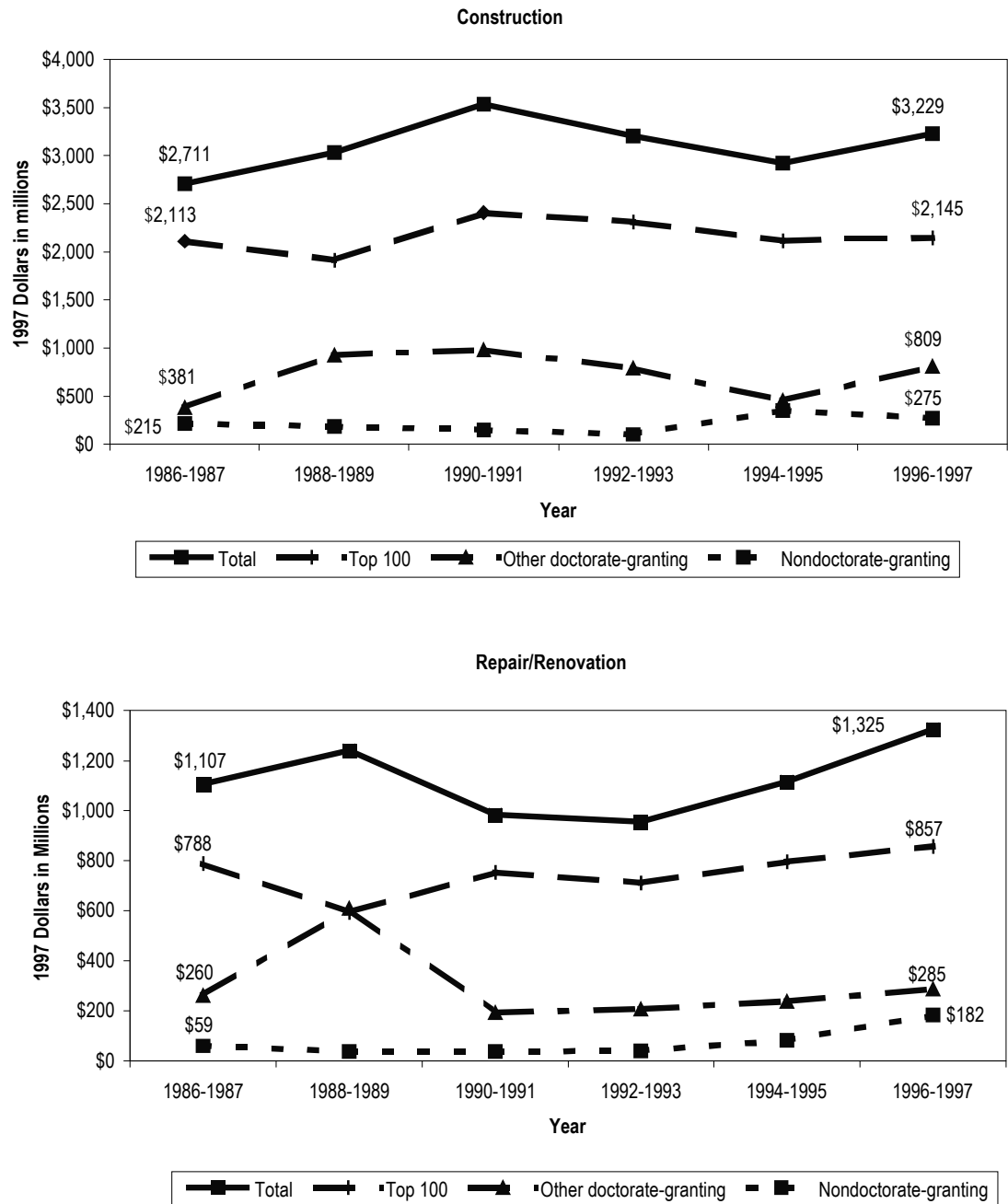
Sources of Funds

Data on the different sources of funds committed to new construction and repair/renovation projects were first collected in 1990 and 1991. At that time, institutional resources provided 55 percent (\$2.47 billion) of the \$4.52 billion spent on the construction and repair/renovation of S&E research space. State and local governments provided 32 percent (\$1.43 billion) of the total combined costs, and the Federal government funded 14 percent (\$0.61 billion).

For 1996 and 1997, institutional resources accounted for 62 percent (\$2.84 billion) of all S&E research space construction and repair/renovation costs (\$4.55 billion). State and local governments provided 29 percent (\$1.32 billion) and the Federal government funded 9 percent (\$0.39 billion).

¹⁰ All dollar figures are adjusted to 1997 levels using the U.S. Bureau of the Census Composite Fixed Price Index for Construction.

Figure 7. Trends in expenditures on science and engineering research space being constructed and repaired/renovated by institution type



Note: All dollar figures are adjusted to 1997 levels using the U.S. Bureau of the Census Composite Fixed Price Index for Construction.

Source: National Science Foundation/SRS, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities; National Science Foundation/SRS, Scientific and Engineering Research Facilities at Colleges and Universities, 1996, Table 3-2, p 3-5.